REMARKS

Applicants have made the foregoing amendments to place the PCT application text in customary US format, so that all the claims can be considered on their merits. In order to avoid excessive filing fees, all multiple-dependent claims have been cancelled. These changes were made for procedural reasons, not for any reason related to patentability. Most of the foreign documents (or their English equivalents) mentioned in the specification are included in the Information Disclosure Statement filed herewith. If the Patent Office notes any remaining informalities which would prevent or hinder examination on the merits, a telephone call to Applicants' counsel is requested.

The original PCT text, on pp. 1-3, contained improper references to the content of the claims, so Substitute Sheets which paraphase that claim content have been provided; care has been taken to avoid introducing "new matter." On page 9, an explanation of the acroynm "EEPROM" has been provided for the uninitiated, and on pages 11 & 14, English-language equivalents of the cited German patents have been identified.

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The marked-up version is captioned "*VERSION MARKED TO SHOW CHANGES MADE.*"

Respectfully submitted,

Milton Oliver

Milton Oliver, Reg. No. 28,333
WARE, FRESSOLA, VAN DER SLUYS
& ADOLPHSON, LLP
PO BOX 224
MONROE, CT 06468
Tel. (203) 261-1234
Fax (203) 261-5676

Att. Docket No. 870-3-139

Attachment: Substitute Sheets
for Specification Pages 1-3, 7, 9, 11, 14 & 20

FIG. 2 shows the terminals of a μC 23. In this exemplary embodiment, a model PIC 16C72 microcontroller of the MICROCHIP company is used. This is an 8-bit processor. It contains a 16-bit timer and an 8-bit timer, two Pulse Width Modulation (PWM) registers, and multiple interrupt functions. This processor of course represents only one example, but it has proven to be the best mode for the embodiment described.

μC 23 has, among others, terminals MCLR 37, VSS 38, CLKIN 39, CLKOUT 40, C1 41, B5 42, B4 43, VDD 44, VSS 45, SDA 46, and SCL 47.

FIG. 3 shows a greatly schematized circuit diagram of a preferred arrangement with one electric motor 32.

The terminals of μC 23 are depicted in FIG. 2, and the corresponding reference characters are used again. Terminal MCLR 37 is connected via a resistor 71 to a positive voltage +5V. Terminals CLKIN 39 and CLKOUT 40 are connected to a quartz oscillator 75. Terminal VDD 44 is connected to +5V and terminal VSS 45 to ground GND, and the two terminals are connected to one another through a capacitor 77. μC 23 has two timers TIMER0 and TIMER1 that are depicted schematically in FIG. 1.

Setpoint frequency f_s passes via a line 25 to a filter FILT_s 51, and from there via a line 53 to terminal B4.

Actual frequency f (corresponding to the rotation speed of motor 32), which is sensed by a rotor position sensor 61, passes via a line 29 to a filter FILT 57, and from there via line 59 to terminal B5 42 of μC 23.

An EEPROM 80 has terminals SDA 81, SCL 83, VDD 89, WP 95, VSS 99, A1 100, A2 101, and A3 103. EEPROM stands for Electrically Erasable Programmable Read-Only Memory.

Terminal SDA 46 of μC 23 is connected via a line 78 to terminal SDA 81 of EEPROM 80 and to an external terminal 105.

EEPROM 80 receives its voltage via terminal VDD 89, which is connected via line 91 to +5V and is additionally protected by a capacitor 93 from voltage spikes; and via terminal VSS 99 that is connected to ground GND. Write-protect terminal WP 95 is taken to ground GND via resistor 97, so that in this exemplary embodiment EEPROM 80 cannot be written to. For the same reason, terminals A1 100, A2 101, and A3 103, which provide address coding, are also connected to ground GND. In this exemplary embodiment, the parameters are permanently written in EEPROM 80. Variants having an EEPROM 80 that can be written to by μC 23 or via bus B are similarly possible; cf. for example PCT Application PCT/EP99/05186 of the Applicant, dated July 21, 1999 <u>whose US national phase is S.N. 09/ 720,221</u>.

The two outputs SDA 81 and SCL 83 are configured as open collector outputs, and are therefore wired to pull-up resistors 85 and 87, respectively.

Setpoint frequency f_s is furnished externally, e.g. from a frequency generator or another motor. Actual frequency f is in this case furnished by sensor 61, which furnishes a constant number of pulses per revolution. Any known type of sensor can be used as sensor 61, e.g. a resolver; a tachogenerator that furnishes an alternating voltage at its output; a Hall generator; or an optical, inductive, or other sensor. Since, in electronically commutated motors, the rotor position is usually sensed by means of one or more Hall generators, the output signal of such a sensor can also be used as the actual frequency, since additional costs for a tachogenerator are then eliminated. The use of a tachogenerator may, however, be advantageous if a high frequency of signal f is desired for the actual frequency, for example if the rotation speed is low, e.g. in the case of a marine diesel with a very low rotation speed.

Filters FILT_s 51 and FILT 57 serve to condition the edges of setpoint frequency f_s and actual frequency f, respectively, so that the presence of an

Comparator 131 compares the two signals u_D and SW. If control output SW is greater than triangular voltage u_D, then PWM signal PWM_M is HIGH; otherwise it is LOW. The pulse duty factor of PWM signal PWM_M is thus controlled by means of the magnitude of control output SW. In FIG. 6B, signal SW increases from left to right. As a result, the pulse duty factor of signal PWM_M in FIG. 6C is also increased from left to right.

Since motor 137 also receives more current and therefore more output via transistor 135 when the pulse duty factor of signal PWM_M is higher, the motor rotation speed can be controlled by way of the magnitude of control output SW.

FIG. 29 shows a variant of FIG. 6. Identical or identically operating parts are therefore given the same reference characters as in FIG. 6. The motor is depicted here as a so-called two-phase, two-pulse electronically commutated motor (ECM) 32" which has, as an example, a two-pole permanent-magnet rotor 732. The latter controls, through its magnetic field, a Hall generator 61 which generates signal f and with that signal also controls the commutation of ECM 32". ECM 32′ can be constructed, for example, in accordance with **DE 23 46 380 C2** <u>and corresponding Müller U.S. Patent **3,873,897**</u>. This is, of course, only one example. The invention is similarly suitable for ECMs having a different number of phases and a different number of rotor poles, as is self-evident to one skilled in the art.

The two phases of ECM 32" are labeled 736 and 738. Current i1 in phase 736 is controlled by an npn Darlington transistor 740 with free-wheeling diode 742, and an npn Darlington transistor 744 with free-wheeling diode 746 serves to control current i2 in phase 738. The emitters of transistors 740, 744 are connected to one another and, through a resistor 748, to GND.

Transistor 740 is controlled by a port OUT1 of μC 23 via an AND element 750, which has signal PWM_M delivered to its other output from PWM adjuster 63. FIG. 29 schematically shows the shape of that output signal, which comprises square-wave pulses at, for example, 25 kHz. The width of said

MEASUREMENT OF ACTUAL VALUE AND SETPOINT OR TARGET VALUE

The measurements of actual frequency f and setpoint frequency f_s proceed identically but independently of one another. It could also be said that they proceed in quasi-parallel fashion, "quasi-" meaning that a true parallel processor (which would also be possible in the context of the invention) is not used in this exemplary embodiment. The discussion below will first address the measurement of actual frequency, the actual frequency being an indication of the rotation speed of motor 32 (FIG. 3).

MEASUREMENT PRINCIPLE

FIG. 22 shows a rotor 32 having a mark 290, and a sensor 61 for mark 290 that serves as rotor position sensor. Rotor 32 is usually part of a motor M. If this is an electronically commutated motor (ECM), it usually has a rotor position sensor 61 which can then also be used for the present invention.

By means of mark 290, rotor position sensor 61 detects a rotor [165,166,167,168] position signal f. Rotor position signal f comprises pulses at points 265, 266, 267, and 268, etc., one revolution of rotor 32 having taken place between each two pulses. The time axis is labeled **t**. These pulses represent "events" in the rotation of rotor 32. In FIG. 22, one event (i.e. one pulse) is generated for each rotor revolution.

By means of rotor position signal **f**, the rotation speed of rotor 32 is measured as described below. At regular intervals T_A a start signal 261, 263, etc. is generated, requesting a new measurement each time.

The start signal at point 261 is followed by pulse 265, and the start signal at point 263 is followed by pulse 268. The measurement takes place between points 265 and 268. The number N of pulses of rotor position signal f occurring after 265 up to and including 268 is measured (i.e. N = 3 in this case), as well as the time Δt(265-268) required for said pulses. The frequency of rotor position signal f, and thus the rotation speed of rotor 32, can be determined therefrom. At each of points 265, 268 of the measurement, an old measurement is terminated and a new measurement is started. The procedure is therefore such that, at the pulse following start signal 261, 263, an old measurement is terminated and a new measurement simultaneously begun each time.